REMEDIAL INVESTIGATION REPORT

HUSTER ROAD SUBSTATION
3800 HUSTER ROAD
ST. CHARLES, MISSOURI

Prepared By:
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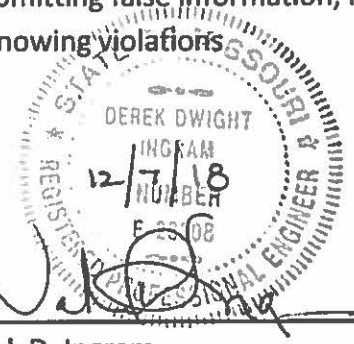
Final

Revision 1

Certification

Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of the report, the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



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List of Abbreviations and Acronyms

AOC	Agreement on Consent
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cis-1,2-DCE	cis-1,2-Dichloroethene
COC	Contaminant of Concern
COPC	Contaminants of potential concern
DNAPL	dense, non-aqueous phase liquid
ft	Feet
GCS	Groundwater Containment System
gpm	Gallons per minute
GW	groundwater
HHRA	Human Health Risk Assessment
HI	Hazard Index
ICs	Institutional Controls
MCL	Maximum Contaminant Level
ug/L	micrograms per liter
MDNR or The State	Missouri Department of Natural Resources
mg/kg	Milligram per kilogram
MNA	Monitored Natural Attenuation
MW	Monitoring Well
NCP	National Contingency Plan
Northern Plume	Downgradient of the Ameren Missouri Huster Road Substation
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and maintenance
Off-site	Downgradient of the Ameren Missouri Huster Road Substation
OU	Operating Unit
ppb	Parts per billion
ppm	Parts per million
PCE	Perchloroethene or Tetrachloroethylene
PCB	Polychlorinated Biphenyl
PZ	Piezometers/monitoring wells
RA	Removal Action
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RSLs	Regional Screening Levels
Site	Ameren Missouri Huster Road Substation
SOW	Statement of Work
TCE	Trichloroethylene
UR	Unit Risk
USEPA or EPA	U.S. Environmental Protection Agency
VI	Vapor Intrusion
VC	Vinyl Chloride
VOC	Volatile Organic Compound
ZVI	Zero Valent Iron

1. INTRODUCTION

1.1. Purpose of the Report

This report consolidates and summarizes numerous site investigations and pilot study reports into a single document and describes the current nature and extent of volatile organic compound (VOC) impacts at the Ameren Missouri Huster Substation site in accordance with the requirements of CERLCA-07-2017-0129, Administrative Order on Consent ("AOC") and its Statement of Work ("SOW").

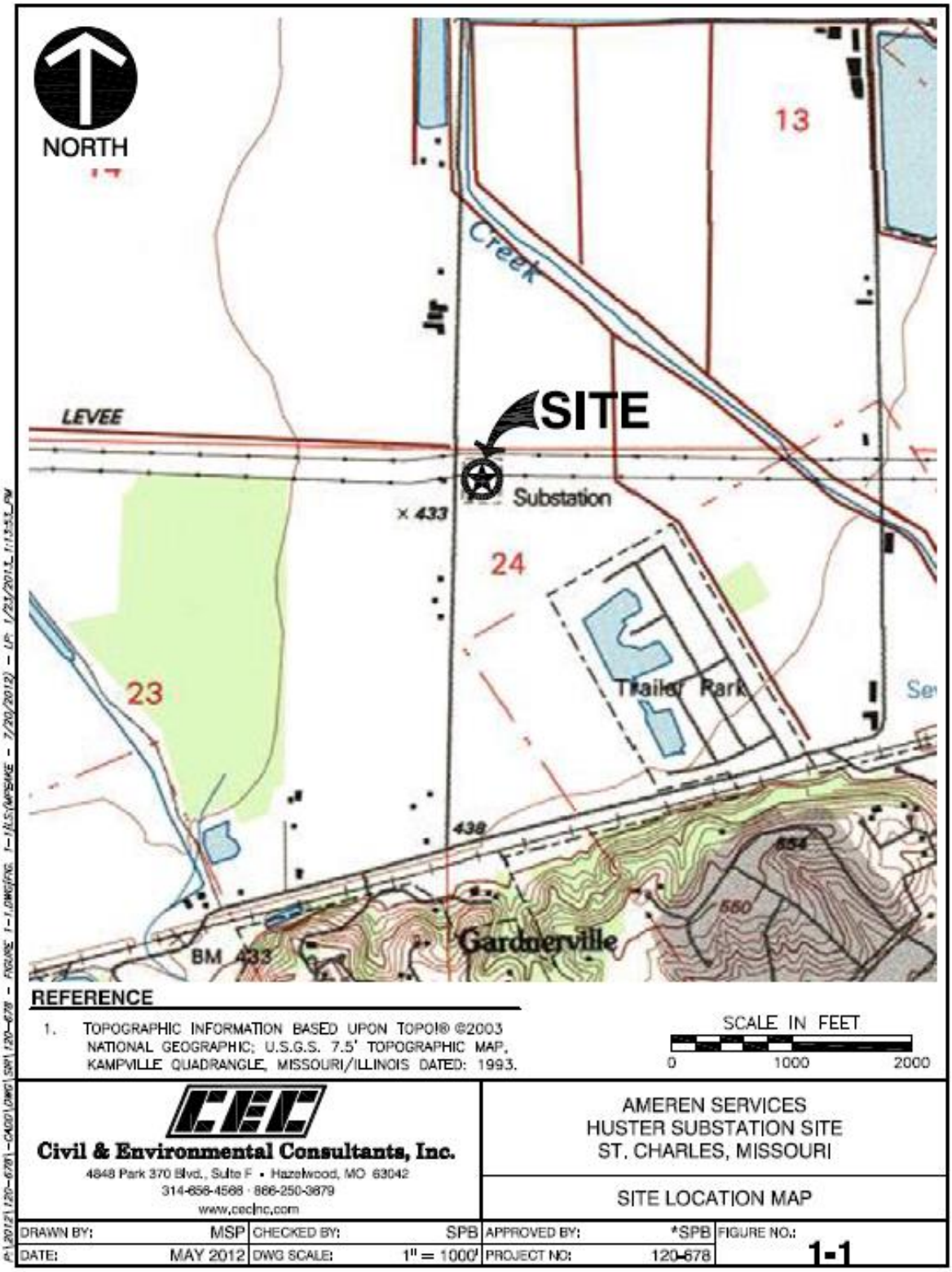
1.2. Site Background

1.2.1. Site Description

The Ameren Missouri Huster Substation, located at 3800 Huster Road, St. Charles, Missouri (the Site), is an active distribution and transmission substation; the site location is shown below. The Site was originally constructed in 1963 and with subsequent expansions now encompasses approximately 8 acres. The Site is protected by a 12-foot high floodwall and gate constructed in 1994 for flood protection. The Site is located within the City of St. Charles Elm Point Wellfield, and adjacent to City Wells 4 and 5. Other wells, specifically City Wells, 6, 7, and the radial well (Well 9) are located north of the Site and the newly installed well 10 is northeast of the Site.

The U.S. Environmental Protection Agency (EPA) has designated this Site as Operable Unit #4 (OU4) of the Findett/Hayford Bridge Road Site due to the presence of common groundwater contaminants and close proximity to Operable Unit #3 of the Findett/Hayford Bridge Road Site (as known as "Findett Corporation Site"). Ameren Missouri is not associated with, or have responsibility for, Operable Units 1-3. The Findett Corporation Site is located to the southwest of the Ameren Missouri Huster Road Substation.

Figure 1 Site Location Map



1.2.2. Site History

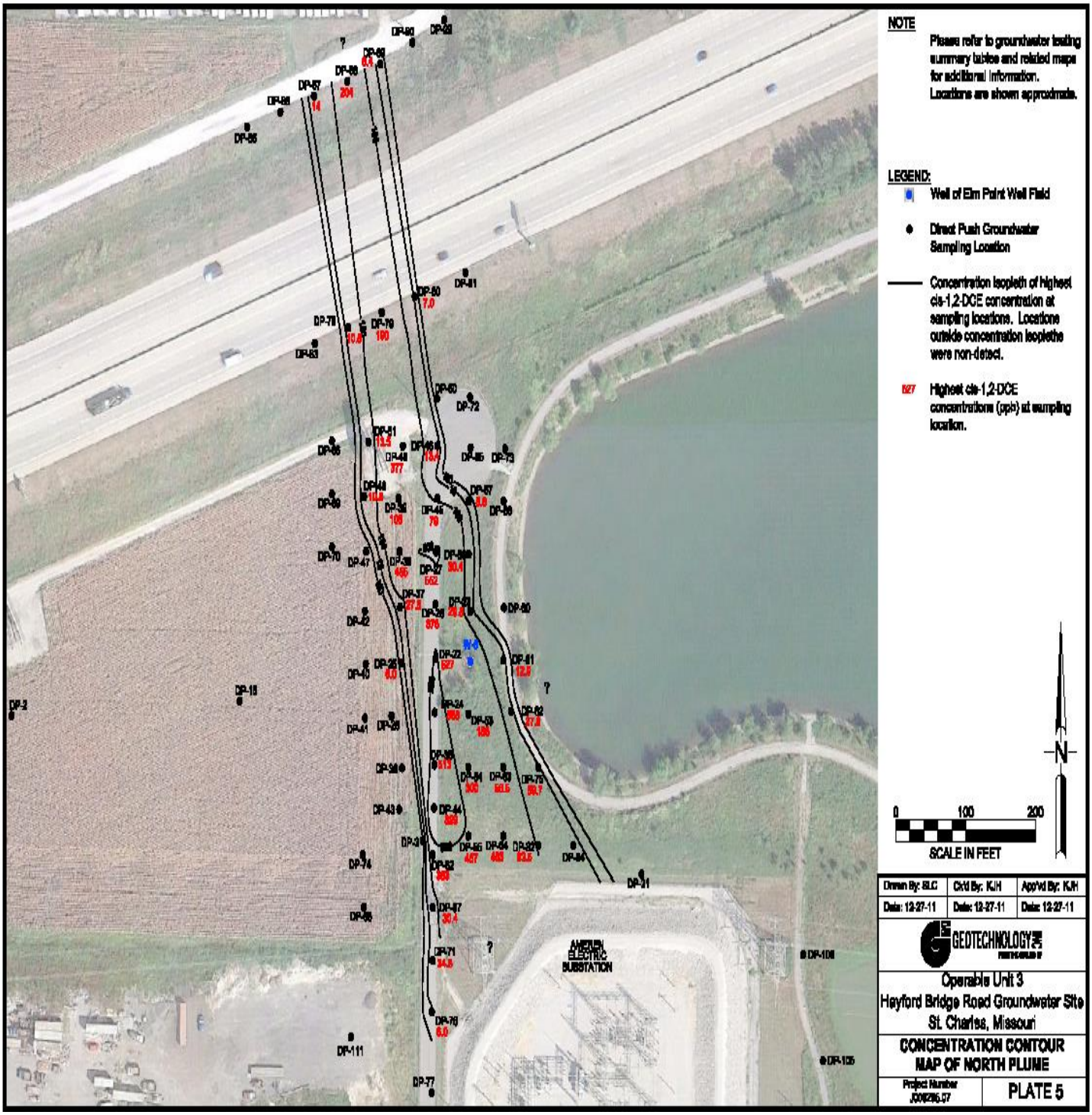
Ameren operates the Site as an active distribution and transmission substation containing the following surface features: a control house, three (3) transformers, two (2) capacitor banks, and all associated equipment including a copper grounding grid embedded within crushed limestone. The substation equipment is surrounded by a twelve (12) foot flood protection berm and is fenced.

Figure 2 - Huster Substation Perimeter

Ameren Missouri previously has used small amounts of chlorinated solvents for degreasing and metal cleaning at the substation. The chemical was manufactured by Mozel Chemical Company and contained approximately 18% *Tetrachloroethylene (PCE)* and mineral spirits.

In June 2010, indications of potential groundwater impacts were first detected in City Well No. 5 located approximately 180 feet north of the substation boundary. Subsequent groundwater investigations by the Findett Potentially Responsible Party (PRP) Group delineated groundwater impacts north of the substation, consisting of *cis-1,2-Dichloroethene* (cis-1,2-DCE) and *vinyl chloride* (VC). Maximum detected concentrations were 828 µg/L (cis-1,2-DCE) and 45.9 µg/L (VC). Figure 3 below contains a summary of the relevant data collected by the OU3 Findett PRP Group. Thereafter, Ameren Missouri independently conducted site investigations in 2012 of soil and groundwater conditions on Site property that indicated the presence of PCE and cis-1,2-DCE concentrations in the soil. After entering into a Settlement Agreement and Administrative Order on Consent dated 12/28/2012, Ameren Missouri continued site investigation activities to further delineate the presence of Contaminants of Concern (COCs) at the Site.

Figure 3 Concentration Contour Map of Off-Site Northern Plume by Third Party



2. Site Geology and Hydrology

2.1. Results of Field Activities

2.1.1. Geology

Site geology consists of a granular surface consisting of limestone rock and sand. This composition is 1-3 feet of rock with the copper grounding cable grid lying within. Beneath the grid is a natural clay/silty clay material (cohesive unit) of 28-32 feet thickness. This unit has intermixed, discontinuous zones of trace to moderate sand. The unit increases silt composition at depth. Underlying the cohesive units is a sand material to an anticipated depth of 110 feet to limestone bedrock contact. The unconsolidated materials above the limestone are a part of the flood plain of the Mississippi River, located approximately 2.8 miles north of the Site. Beneath each substation transformer, as part of the facility construction, a sump extends to a depth of 8-10 feet below ground surface (bgs) over an area slightly larger than the transformer coverage. This sump is filled with 3-4" limestone rock.

2.1.2. Hydrogeology

Shallow excavations within the substation typically fill with water that appears to be perched water sitting on top of the native clay soil. As drilling continues deeper, the saturation depth typically appears at around 18 feet below ground surface (bgs) in the silty clays. No free water is observed until the sand unit is penetrated at approximately 30 feet bgs. The sand is a semi-confined unit; wells screened in this unit (35-45 feet bgs) have varying static water levels dependent upon season and Mississippi river elevations. In September 2012, depths to water were between 21 and 23 feet bgs. In April 2013, while the Mississippi River was above flood stage, depths to water in these same wells ranged from 11-12 feet bgs.

Measuring of groundwater elevations at various times indicates a consistent flow direction to the north-northwest with a typical gradient of 0.0007 ft/ft.

3. Site Investigations

3.1. Contaminant Source Investigations

Initial soil testing in 2012 of the Huster Road Substation sampled for tetrachloroethylene to determine whether the contaminant was present and if so whether such substance could potentially be a source of groundwater contamination. (See full *Site Investigation Data and Documents* Report June 2014 in Appendix A).

The initial site investigation identified the presence in both the soil and groundwater of the COCs near electrical equipment, with the highest concentrations being near transformer No.2. The 2012 site investigation identified the following concentrations in soil borings and groundwater:

	PCE (ppb)	TCE (ppb)	cis-1,2-DCE (ppb)	VC (ppb)
Soil – SB41 @27'	159,000	14,200	9,540	229
Groundwater GW-100 (33-37')	73 J	<125	3,260	270

3.1.1. Soil Investigations

During the initial site investigation, a total of forty-four (44) soil borings were drilled at the Site. The site soil was logged consistently as plastic, medium gray-brown silty clay to a depth of 30-34 feet where the lithology transitioned to a fine to medium-grained sand. All borings remained in this sand unit to depths up to 104 feet, the maximum soil sampling depth at the Site. Soil Boring locations are identified on Figure 4.

3.1.2. Groundwater Investigations

A total of 44 groundwater samples (see Figure 5 and Appendix A) (including GW-100) have been profiled to various depth intervals on Ameren's property. Groundwater profiling performed by Major Drilling at location GW-100 started at the depth interval of 103-107 feet (the bedrock surface); samples were obtained at 10-foot intervals up to the last sample at 33-37 feet. Groundwater profiling conducted at locations GW-01 through GW-04 had a maximum sampling depth of 60 feet, whereas GW-05 through GW-27 were sampled down to 40 feet. GW-28 through GW-43 had a maximum sampling depth range of 100 to 106 feet. There was no indication of (DNAPL) observed at the Site.

- Groundwater samples were collected under low-flow sampling conditions after purging approximately 1-2 gallons of water from each discrete sampling interval. Groundwater samples were taken every four feet from 16 ft down to bedrock encountered at 100 ft.

A total of seventeen (17) monitoring wells (see Figure 6) have been installed on the Site, three (3 - (MW-39, 40 & 41)) of which are screened in the perched waters of the cohesive unit of the substation at three (3) different depths around transformer no. 2.

Based upon the results of the site investigations, Ameren Missouri implemented a series of pilot studies that tested various soil and groundwater treatment applications and installed a groundwater containment system (GCS) along the northern border of the Site. A timeline of major field activities conducted at the Site is set forth in Table 1 below and the various pilot studies are described in section 5.0.

Figure 4- Soil Boring locations

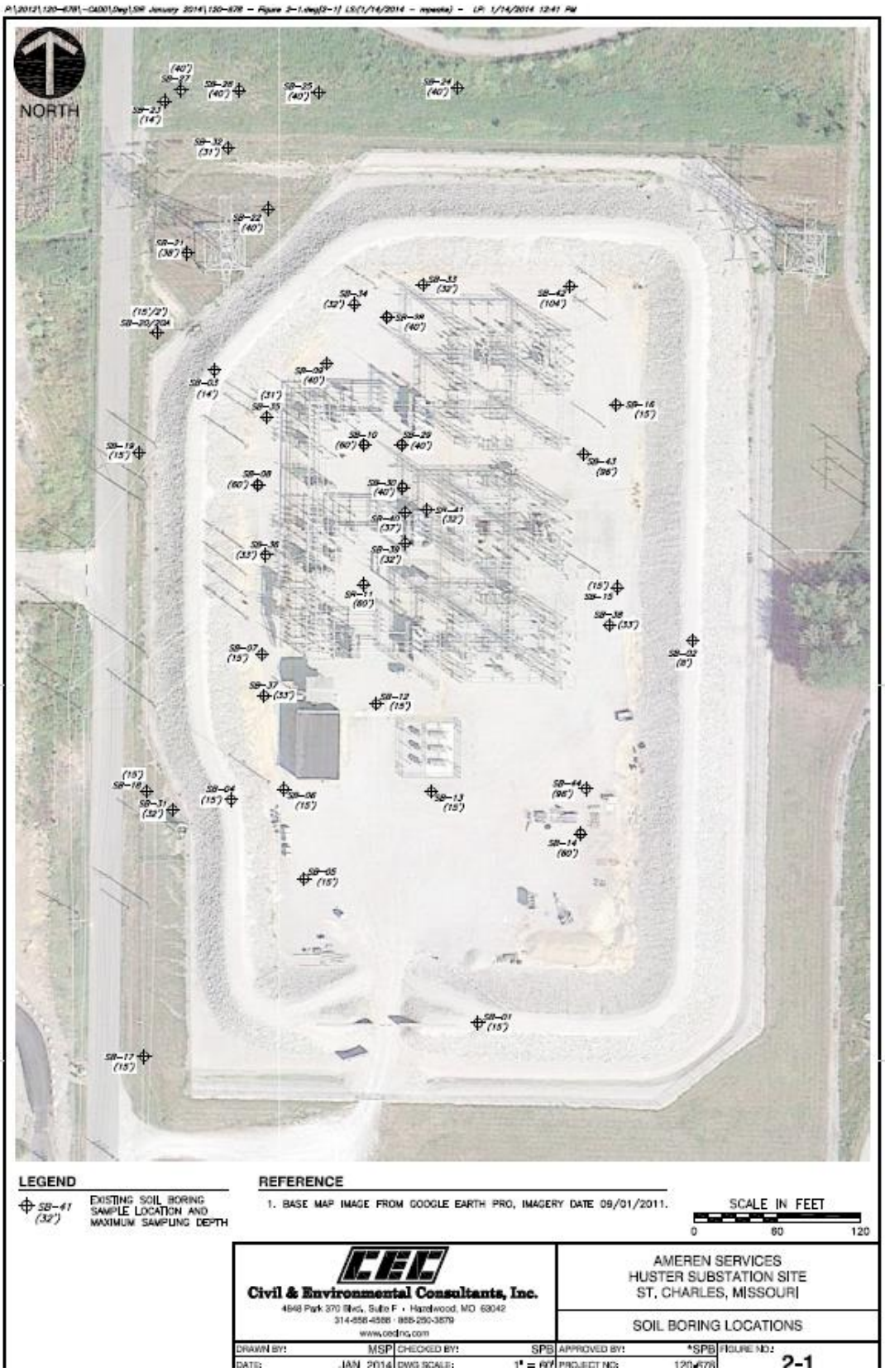


Figure 5 - Groundwater Sampling Locations

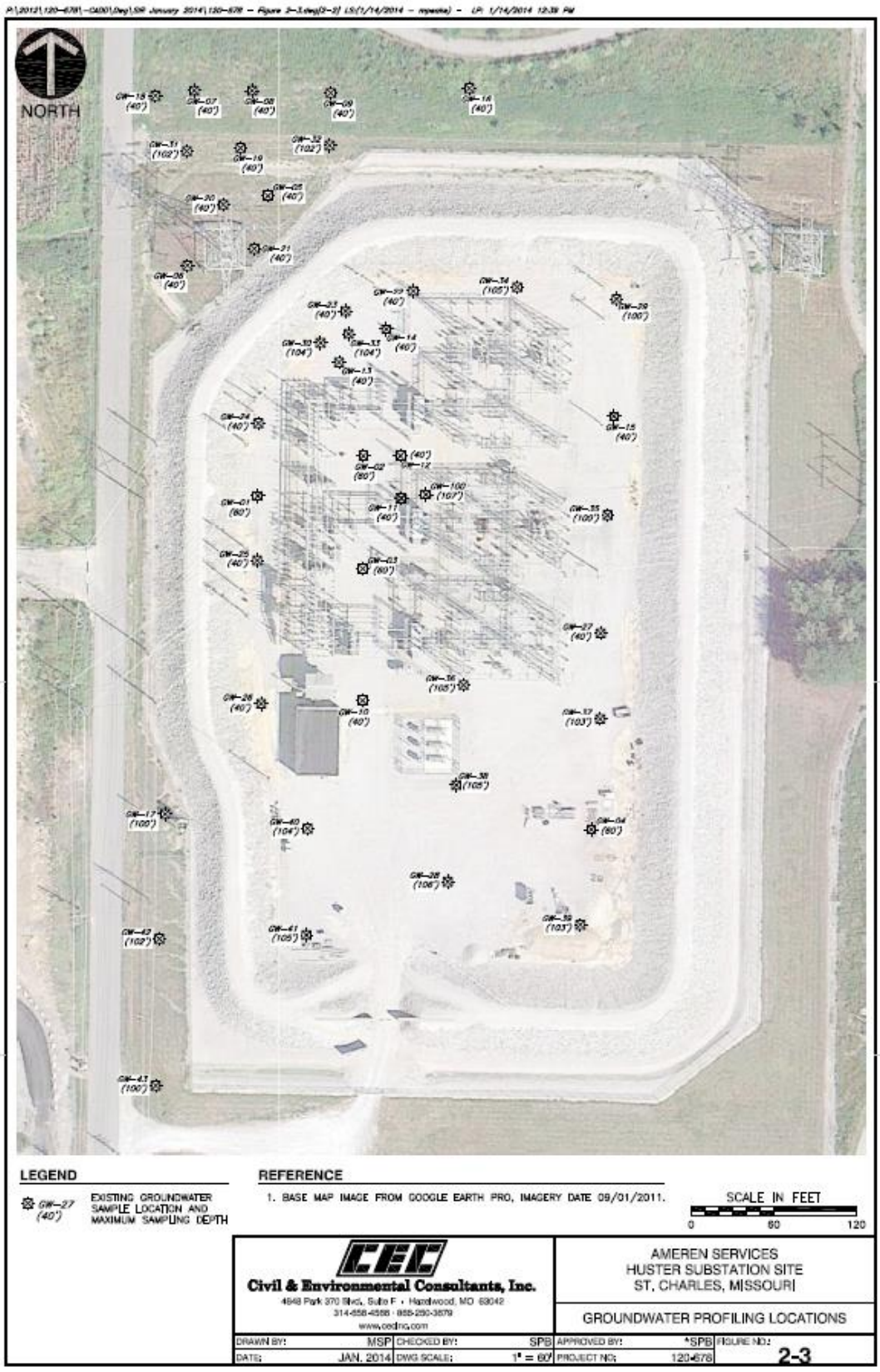


Figure 6- Site Monitoring well locations, past and current analytical data

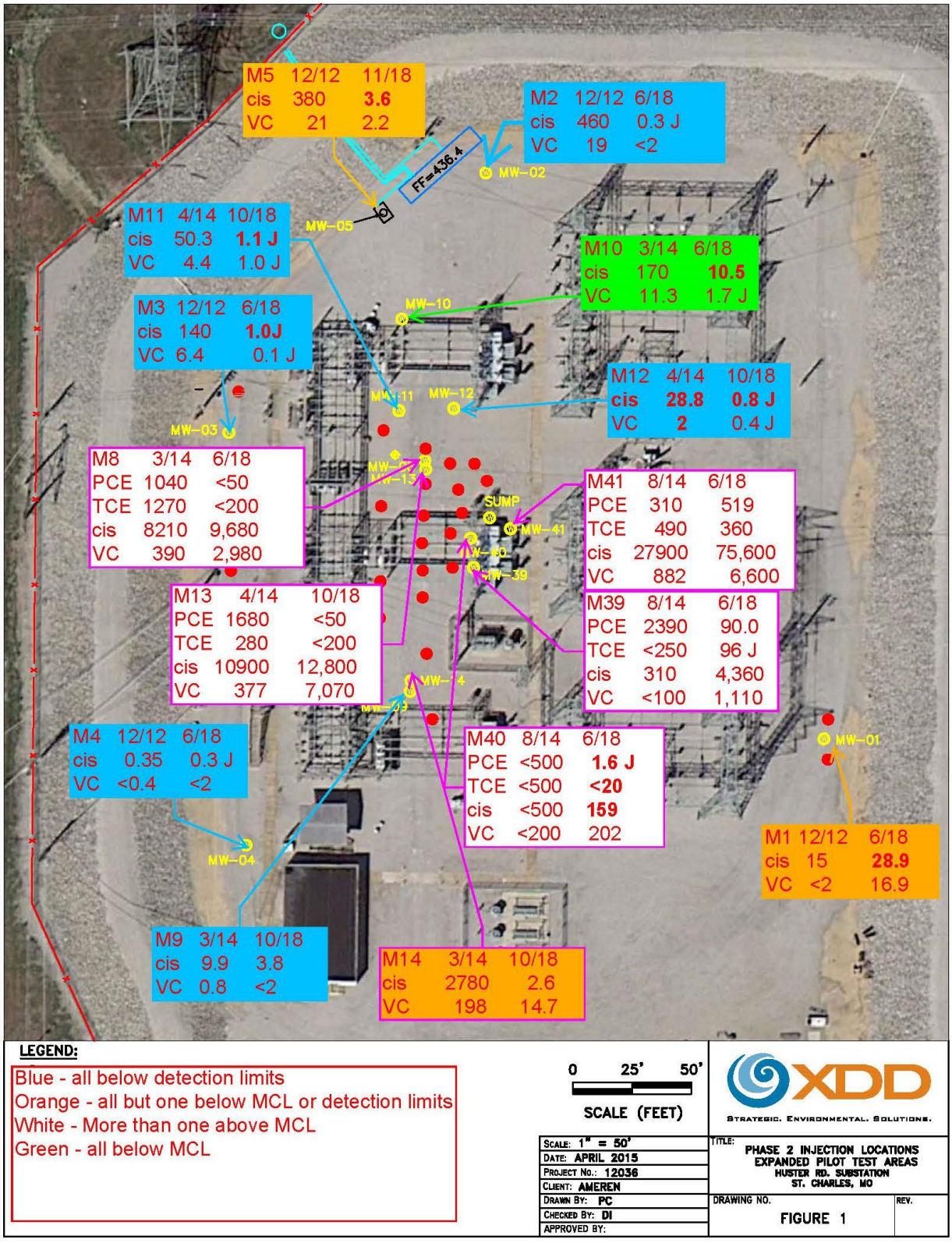


Figure 6 modified by Ameren.

Table 1: Timeline of major field activities that were conducted at the Site

2012	2013	2014	2015	2016	2018
April - surface and subsurface soil sampling	**December** – subsurface soil sampling and groundwater profiling.	**March** - On-Site Pilot Study In-situ remediation technologies – injections into clay: Zero Valent Iron EHC® (zero-valent iron with controlled release carbon and nutrients) injections, Potassium Permanganate injections; Injections into groundwater – Bio-augmentation	**April** - **On-Site Pilot Study #2** soil treatment: Injections into clay: Sodium Permanganate injections around Transformer #2. **Off-Site treatment**: Completed the injection of Sodium Persulfate into groundwater near City Well #5	**October** - On-Site Pilot Study #3: Injections into groundwater: Bio-Augmentation	**August –** On-Site Pilot Study #4: Injection of sodium permanganate into the clay around transformer 2: Injection of Bio-augmentation into groundwater around MW-9, MW-14, MW-8, MW-13 and feeding of biomass at MW-11 & 12.
June – Subsurface soil sampling and groundwater profiling		**March** - On –Site Installation of Groundwater Containment System			
July – groundwater profiling, subsurface soil sampling and test pits sampling adjacent to transformers		**November** – Off-Site Treatment Pilot Study - Installation of two (2) zero-valent iron EHC® permeable barriers downgradient from City Well #5 and south of 370			
August – Subsurface soil sampling , groundwater profiling, MW installations, slug tests and well gauging		**November** – Off-Site Treatment Pilot Study - Injection of Sodium Persulfate into groundwater near City Well #5			
November – subsurface soil sampling and groundwater profiling					

4. Nature and Extent of Contamination

4.1. Nature

The source of PCE contamination and its degradation products at the Site may be from the limited use during maintenance activities of the product Mozel which contained 18% PCE. It was used to clean oily surfaces prior to maintenance on substation equipment. The location of the highest COCs is near transformer No. 2.

4.2. Extent

The initial site investigation identified the presence of the COCs on site near electrical equipment, in both the soil and groundwater, with the highest concentrations being near transformer no.2. The 2012 site investigation, SB-41 at 27.5', COC concentrations of 159,000 ppb PCE, 14,200 ppb TCE and 9,540 ppb cis-1,2-DCE and 229 ppb VC were detected in the soil. In the groundwater, GW-100 (33-37'), detections were: PCE – 73J ppb; TCE<125 ppb; cis-1,2-DCE 3260 ppb; VC 270ppb.

Subsequent to those initial results, additional investigation further delineated the extent of COCs on the Site. Groundwater samples were taken at depths to 60 feet with several locations (GW17, GW28 – GW43, GW100) going to top of bedrock (up to 100 feet) to check for the presence of dense, non-aqueous phase liquid (DNAPL). Based upon that investigation, the extent of groundwater contamination above MCL concentrations was limited to 45 feet and above, except at one location (GW100) where the MCL was exceeded for PCE (MCL 5 ug/L) at depths 53-87 feet (5.4 ug/L @ 50-60', 12.7 @ 67' & 6.1 ug/L @87'). There was no indication of (DNAPL) observed at any sampling location at the Site. The results of those sampling activities are contained in the *Site Investigation Data and Documents* Report June 2014 (Appendix A), previously submitted to USEPA and the Missouri Department of Natural Resources (MDNR).

4.2.1 Soil

Soil concentrations of target compounds have been greatly reduced following application of treatment technologies used during the various pilot studies performed at the Site (see Section 5.0). Sampling data reflects a dramatic decrease of COC concentrations following the injection of both potassium (pilot study #1) and sodium (pilot studies 2 & 4) permanganates into the clays at the Site. Below is a chart depicting mass reductions observed over a four-year period as a result of Pilot Studies #1 and #3.

4.2.2 Groundwater

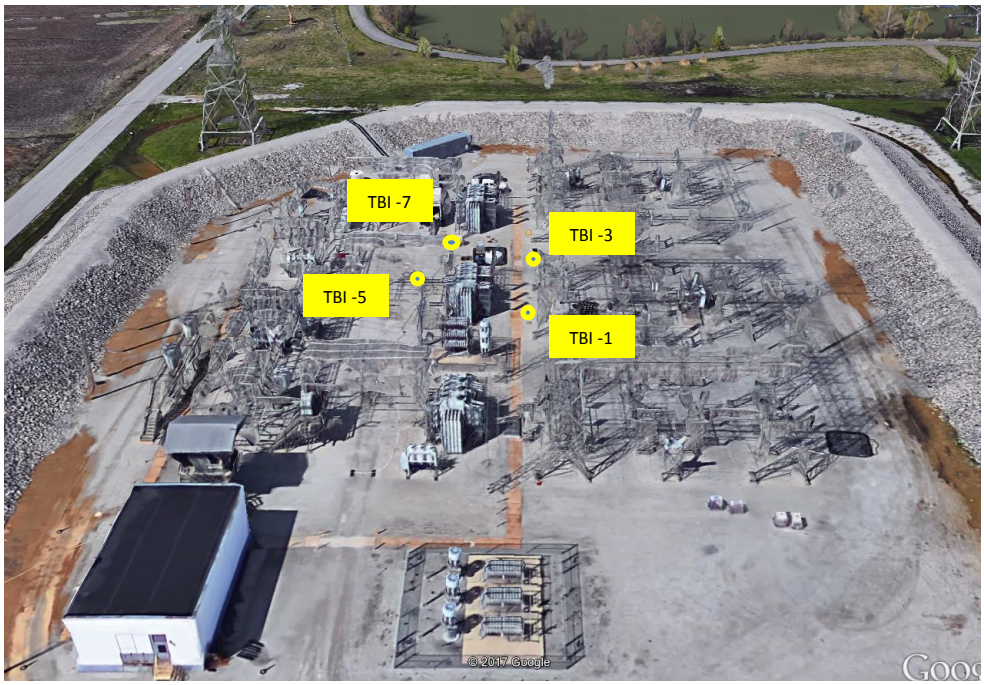
4.2.2.1 Off-Site area of potential impacts north of the Site: Following the off-site groundwater treatment activities in pilot study #2 (i.e. sodium persulfate groundwater treatment near City Well No. 5 and the installation of the EHC permeable barriers south of 370), COC concentrations in groundwater are were below MCLs for all wells in this area and below detection limits at all but three wells. The concentration levels both pre- and post-study is presented in Figure 7 for North of 370 and in Figure 8 for south of 370.

4.2.2.2 The Site

Sampling data reflect that dense, non-aqueous phase liquid (DNAPL) is not present at the site as reflected the *June 2014 Site Investigation Data and Documents Report* June. *See* Appendix A.

The operation of the GCS has been effective in keeping COCs from the Site from migrating into the former plume area north of the Site. In addition, the onsite pilot studies (see section 5.0) have been effective in reducing the COCs concentrations in the groundwater in a short period of time. Of the seventeen monitoring wells for the Site, eight are now below MCL for all COCs, two are below MCL for three out of four COCs while five are above MCL for two or more of the COCs. This is an improvement from pre-pilot test concentration levels in that there were only two monitoring wells that were below the MCLs for all COCs. Below is a chart reflecting such reductions following post-study implementation.

Table 2: Huster Substation – 2017 – Soil Data

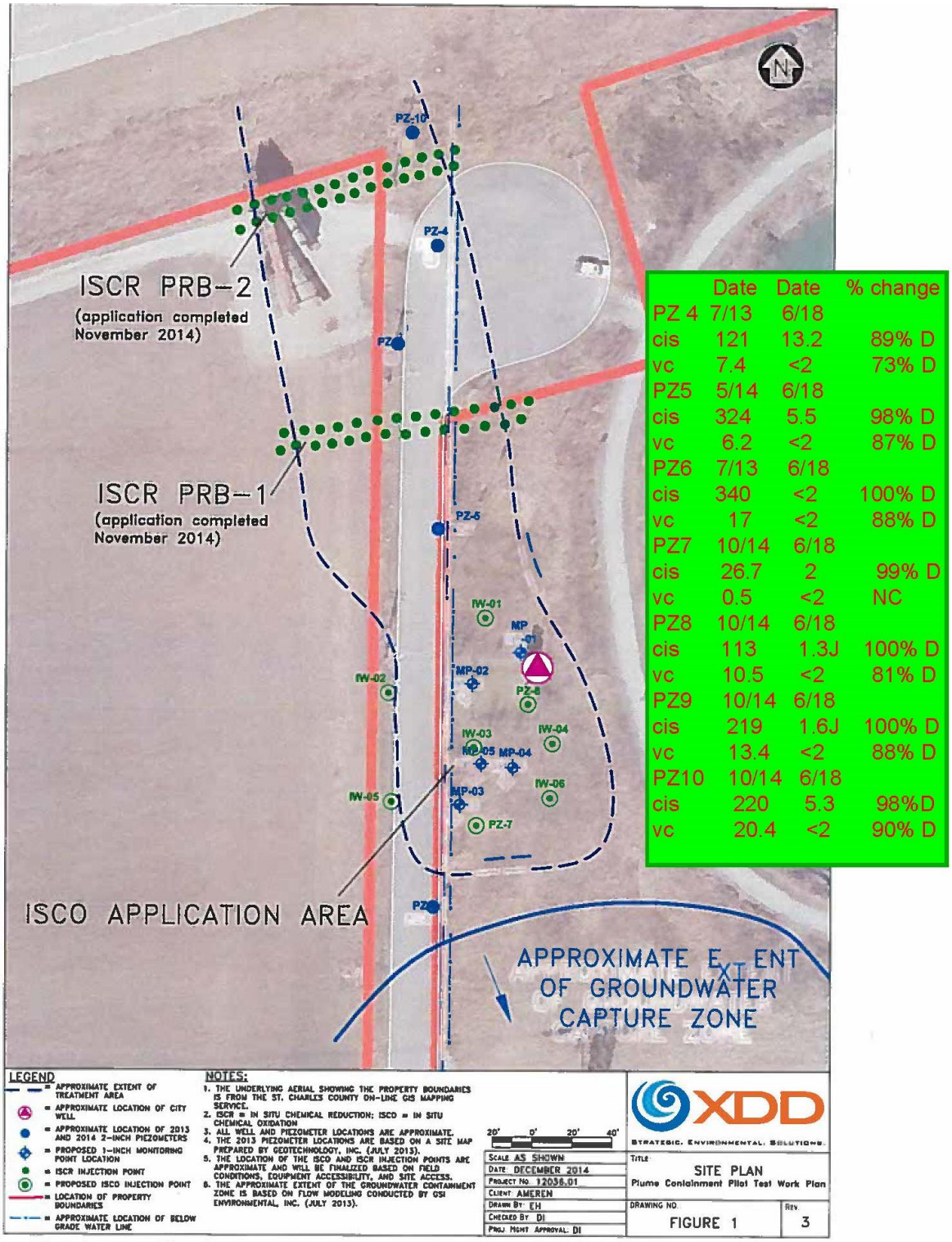


Depth of sample		7.5’		% Change	17.5’		% Change	27.5’		% Change
Year Unit of measure		2012 ug/kg	2016 ug/kg		2012 ug/kg	2016 ug/kg		2012 ug/kg	2016 ug/kg	
TBI -1 (SB-39 (2012) the closest)	PCE	<150	<5.7	UK	330	20.5	94	363	1.6 J	100
	TCE	<150	<5.7	UK	130 J	51.9	60	38 J	3.1 J	100
	cis-1,2-DCE	1,340	1.2J	100	2,310	526	77	350	55.8	84
	Vinyl Chloride	314	2.0J	100	166	26.6	84	222	4.5	98
TBI-3(near SB-41(2012))	PCE	35,000	<5.7	100	147,000	<4.9	100	159,000	2.2 J	100
	TCE	6,780	<5.7	100	14,400	<4.9	100	14,200	<6.3	100
	cis-1,2-DCE	10,700	<5.7	100	11,400	28.3	99.7	9,540	5,740	40
	Vinyl Chloride	450	1.0 J	100	280 J	41.6	85	229	489	113 I
TBI-5 (no corresponding 2012 location)	PCE	-	<5.8	UK	-	38.9	UK	-	7.4	UK
	TCE	-	<5.8	UK	-	147	UK	-	5.7J	UK
	cis-1,2-DCE	-	29.8	UK	-	1,160	UK	-	295	UK
	Vinyl Chloride	-	5.3	UK	-	102	UK	-	4	UK
TBI-7(near SB-10 (2012))	PCE	<5.6	<5.9	NC	1,020	<4.7	100	15,600	<5	100
	TCE	<5.6	<5.9	NC	860	<4.7	100	3,470	<5	100
	cis-1,2-DCE	17.6	6.8	61	2,910	533	82	8,850	4,820	46
	Vinyl Chloride	7.3	0.7 J	99	169	119	30	209	364	74 I

I = Increase UK = Unknown NC = No Change

Figure 7 - Off-Site Current Results North of 370

Figure 8 - Off-Site Current Results South of 370



	Date	Date	% change
PZ 4	7/13	6/18	
cis	121	13.2	89% D
vc	7.4	<2	73% D
PZ5	5/14	6/18	
cis	324	5.5	98% D
vc	6.2	<2	87% D
PZ6	7/13	6/18	
cis	340	<2	100% D
vc	17	<2	88% D
PZ7	10/14	6/18	
cis	26.7	2	99% D
vc	0.5	<2	NC
PZ8	10/14	6/18	
cis	113	1.3J	100% D
vc	10.5	<2	81% D
PZ9	10/14	6/18	
cis	219	1.6J	100% D
vc	13.4	<2	88% D
PZ10	10/14	6/18	
cis	220	5.3	98%D
vc	20.4	<2	90% D

Figure 8: Modified by Ameren

Table 3: Pre-2018 and 2018 MW Data: (MWs #2 & 4 are not on chart as they have been below detection limits for all COCs for a long period of time see Appendix E)

Well	Date	Tetrachloroethene (PCE) (ug/L)	Trichloroethene (TCE) (ug/L)	cis-1,2-DCE (cis) (ug/L)	Vinyl Chloride (VC) (ug/L)
MW-1	04/01/2014	**<5**	**4.2 J**	188	9.7
	6/5/2018	**<0.5**	**<2.0**	**28.9 (85% decrease)**	16.9 (74% increase*)
MW-3	12/03/2012	**0.56**	**<0.29**	140	6.4
	6/5/2018	**<0.5**	**<2.0**	1.0 J (100% decrease)	**0.1 J** (100% decrease)
MW-5	12/07/2012	**<0.28**	**<0.29**	380	21
	6/5/2018	**<0.5**	**<2.0**	6.1 (98% decrease)	7.4 (65% decrease)
MW-6	12/03/2012	**<0.28**	**<0.29**	590	21
	6/5/2018	**<0.5**	**<2.0**	1.0J (100% decrease)	**<2 (100% decrease)**
MW-7	12/03/2012	**<0.28**	**<0.29**	83	5.9
	6/5/2018	**<0.5**	**<2.0**	1.6 J (100% decrease)	**<2 (100% decrease)**
MW-8	03/13/2014	1040	1270	8,210	390
	6/5/2018	<50 (95% decrease)	<200 (84% decrease)	9,680 (18% increase*)	2,980 (664% increase*)
MW-9	3/12/2014	<5	<5	9.9	0.8
	10/16/2018	<0.5	<0.5	3.8	<2.0
MW-10	03/13/2014	46.1	47.1	170	11.3
	6/5/2018	<0.5 (100% decrease)	<2.0 (100% decrease)	10.5 (94% decrease)	**<1.7 J (100% decrease)**
MW-11	05/20/2014	<50	<50	551	54.1
	10/16/2018	**<0.5**	**<2.0**	**1.1 J (100% decrease)**	**1.0 J (100% decrease)**
MW-12	03/20/2014	**<5**	<10	319	21.8
	10/16/2018	**<0.5**	**<2.0**	**0.8 J (100% decrease)**	**0.4 J (100% decrease)**
MW-13	04/25/2014	1680	280	10,900	377
	10/16/2018	<50 (97% decrease)	<200	12,800 (17% increase*)	7,070 (1,775% increase*)
MW-14	03/14/2014	<100	<100	2,780	198
	10/16/2018	**<0.5 (100% decrease)**	**<2 (100% decrease)**	**3.3 (100% decrease)**	18.1 (91% decrease)
MW-39 (in clay)	08/27/2014	2390	< 250	310	< 100
	6/6/2018	90 (96% decrease)	96 J (52% decrease)	4,360 (1,360% increase*)	1,110 (1,010% increase*)
MW-40 (in clay)	08/27/2014	<500	<500	<500	<200
	6/6/2018	**<1.6 J (100% decrease)**	<20 (96% decrease)	159 (68% decrease)	202 (no change)
MW 41 (in clay)	08/27/2014	310	490	27,900	882
	6/6/2018	519 (67% increase)	360 (26.5% decrease)	75,600 (1,710% increase*)	6,600 (6,483% increase*)

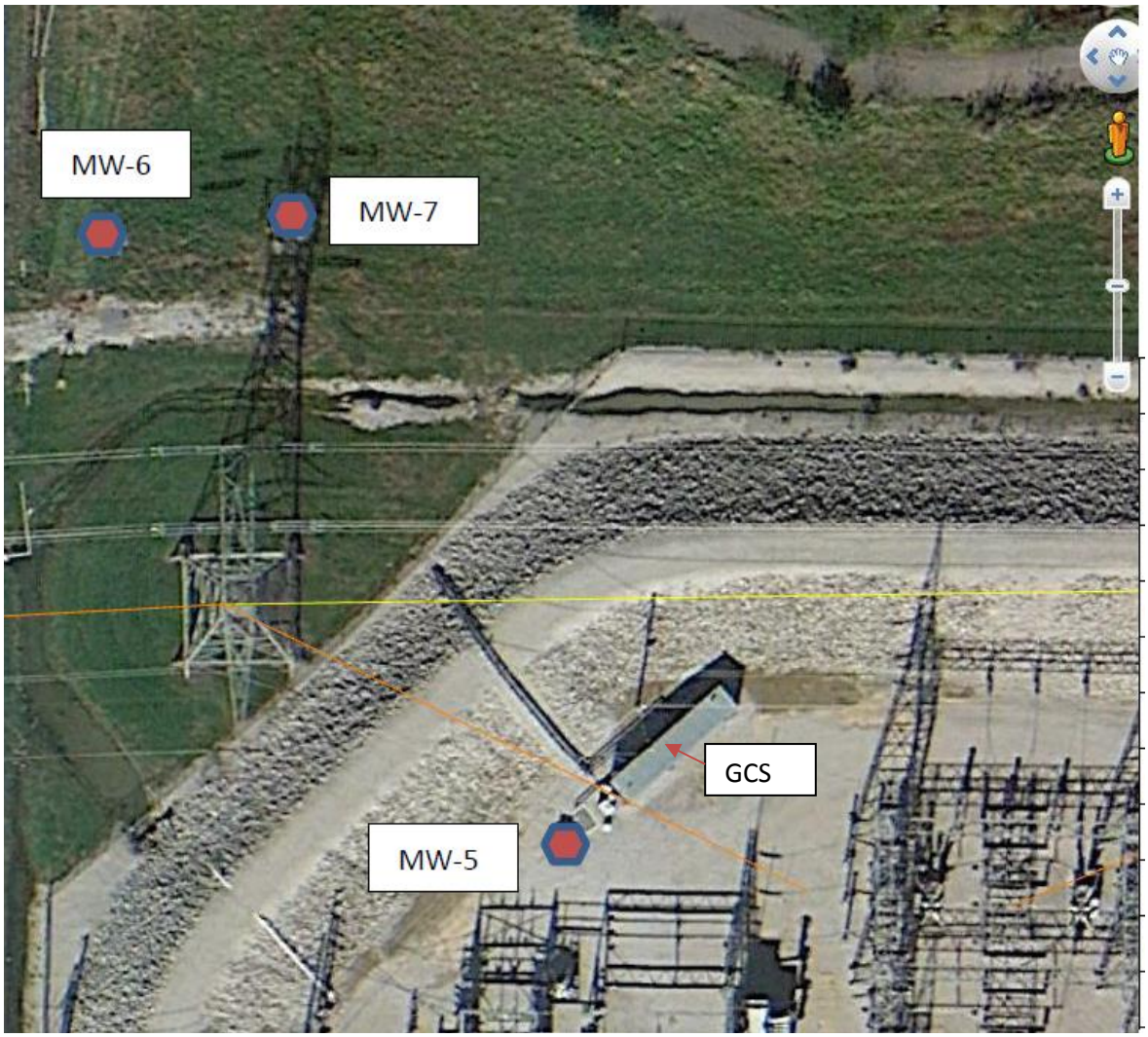
Blue is the most recent sampling data. Green denotes below the MCL. * reflects normal decomposition process

5.0 Pilot Studies

5.1 Groundwater Containment System

In March 2014, Ameren Missouri installed a GCS as part of its implementation of obligations set forth in the Settlement Agreement and Administrative Order on Consent, CERCLA-07-2012-0025. The objective of the GCS was to prevent COCs identified in the groundwater at the Site from migrating offsite and northward towards the City's drinking water wells. Three extraction wells operating at approximately 62 gallons/minute route captured groundwater through air stripper prior to discharge via an NPDES outfall permitted by MDNR. (NPDES permit #MO-0137642). Extraction wells MW-6 and MW-7 are located at Ameren Missouri's property boundary to ensure that impacted water does not leave the Site. Placement of the GCS is depicted in Figure 9 below.

Figure 9 - Location of GCS and its three extraction wells



The GCS has been very effective in maintaining the COCs in the groundwater on-site and there has been no rebound in COCs in off-site groundwater even after completion of the pilot studies offsite groundwater treatment. Sampling reflects that off-site groundwater is below MCLs for all COCs. See Figures 7 & 8.

5.2 Pilot Study #1 - In-situ soil and groundwater remediation technologies

The initial pilot study was conducted inside the substation in March 2014 and evaluated the potential performance of three different in-situ remediation technologies in limited areas near electrical equipment on the Site: zero valent iron, potassium permanganate and bio-augmentation. Within five months following the injection of potassium permanganate into three groundwater wells and at different clay depths near transformer No. 2 and its sump, PCE and TCE decreased by 50 – 96%. Decreases in PCE and TCE were also observed following the injection of EHC – zero valent iron into soil areas of high impact. As a result of the biomass injection in groundwater, dramatic improvements in concentration levels were observed with PCE and TCE below detection limits, cis-1,2DCE below the MCL and VC slightly above the MCL. Details of this pilot study can be found in Appendix B – "*Pilot Study Report – September 15, 2014*".

5.3 Pilot Study #2 - Off-Site Groundwater & On-Site Soil Remediation Technologies

To evaluate and address impacted groundwater located north of the substation – commonly called the "Northern Plume", Ameren conducted a second pilot study in November 2014 and April 2015. The second pilot study encompassed the injection of a double *EHC-enhanced ZVI* permeable barrier north of City Well no. 5 and south of Highway 370, *sodium persulfate* injections as groundwater treatment near City Well no. 5 (see Figures 10 & 11) and injection of *sodium permanganate* (April 2015) into the clay layer inside the levee area of the Site in areas of highest impact of COCs near transformer No. 2.

5.3.1 Off-Site Pilot Summary

Two (2) twenty foot (20') wide permeable EHC® ZVI barriers were installed using a total of 30, 700 lbs of EHC®, covering a total of 3,800 sf. EHC® is a product which combines zero-valent iron (ZVI) with controlled-release carbon and nutrients to promote strong reducing conditions when applied in subsurface environments, creating conditions that facilitate rapid degradation and complete destruction of chlorinated organics.

Within one year of the installation of ZVI permeable barriers, groundwater samples at PZ10 (the last monitoring well after the ZVI permeable barriers on the south side of 370) were below MCLs for all COCs. In addition, as of 12/15, sampling data from, PZ-2 (north of 370) was below the MCL for cis-1,2-DCE and VC with only two quarters where VC was only slightly above MCL (See appendix D). Currently PZ-2 below the MCL for all COCs (see Figure 7 for the current analytical results).

Following the injection of sodium persulfate around City Well No. 5, COC concentrations levels were reduced to below MCL within eight months. There has been no rebound in concentration levels and sampling data from the PZs around City Well no. 5 continue to be below MCL and the majority of sampling data in this area is below detection limits for the COCs. (See Figures no. 8 for the most current analytical results south of 370).

A full report of the second pilot study can be found in Appendix C - *Interim Summary of 2014/2015 Expanded Pilot Tests* – January 2016.

Figure 10 - Locations of Off-Site Pilot Study #2

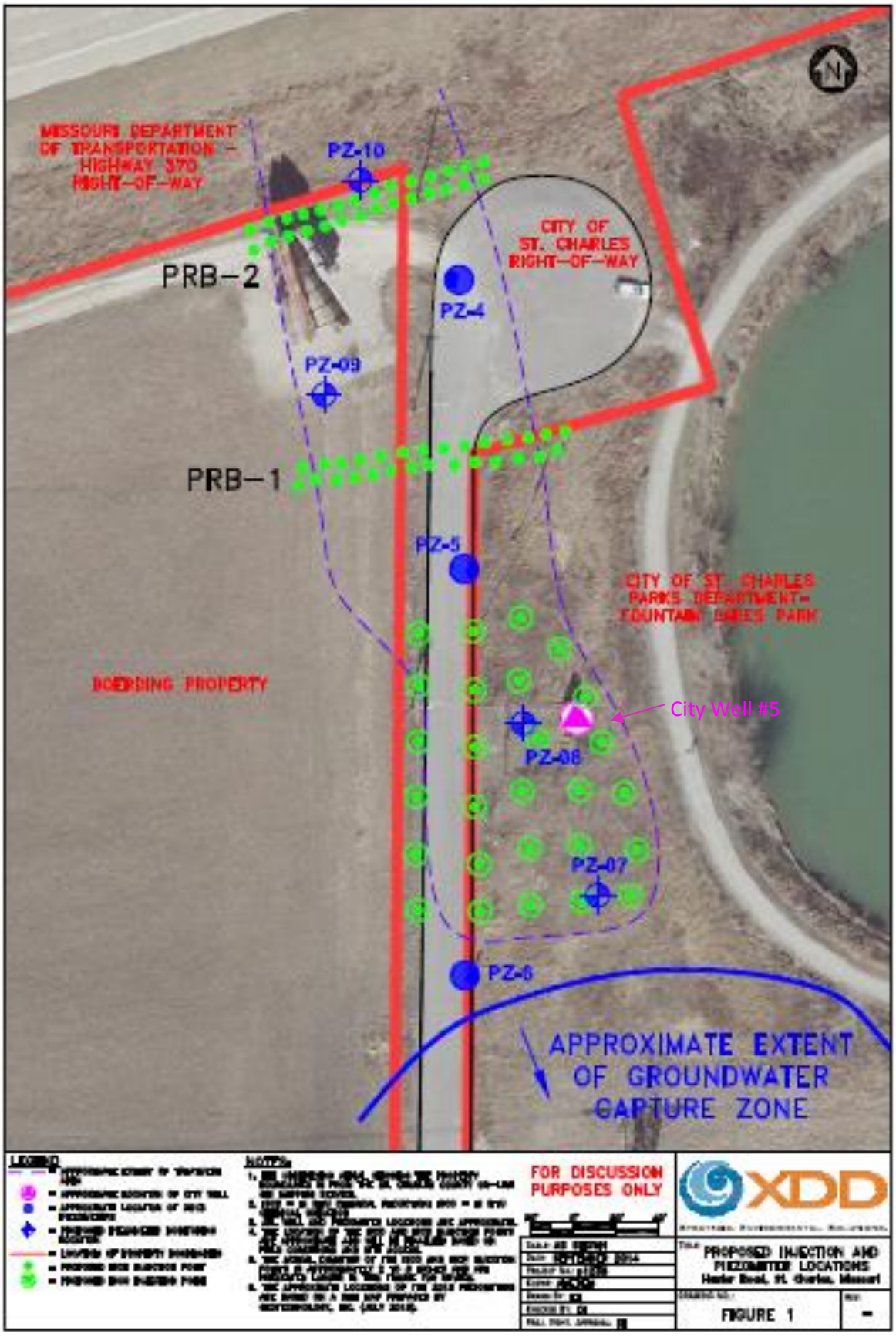
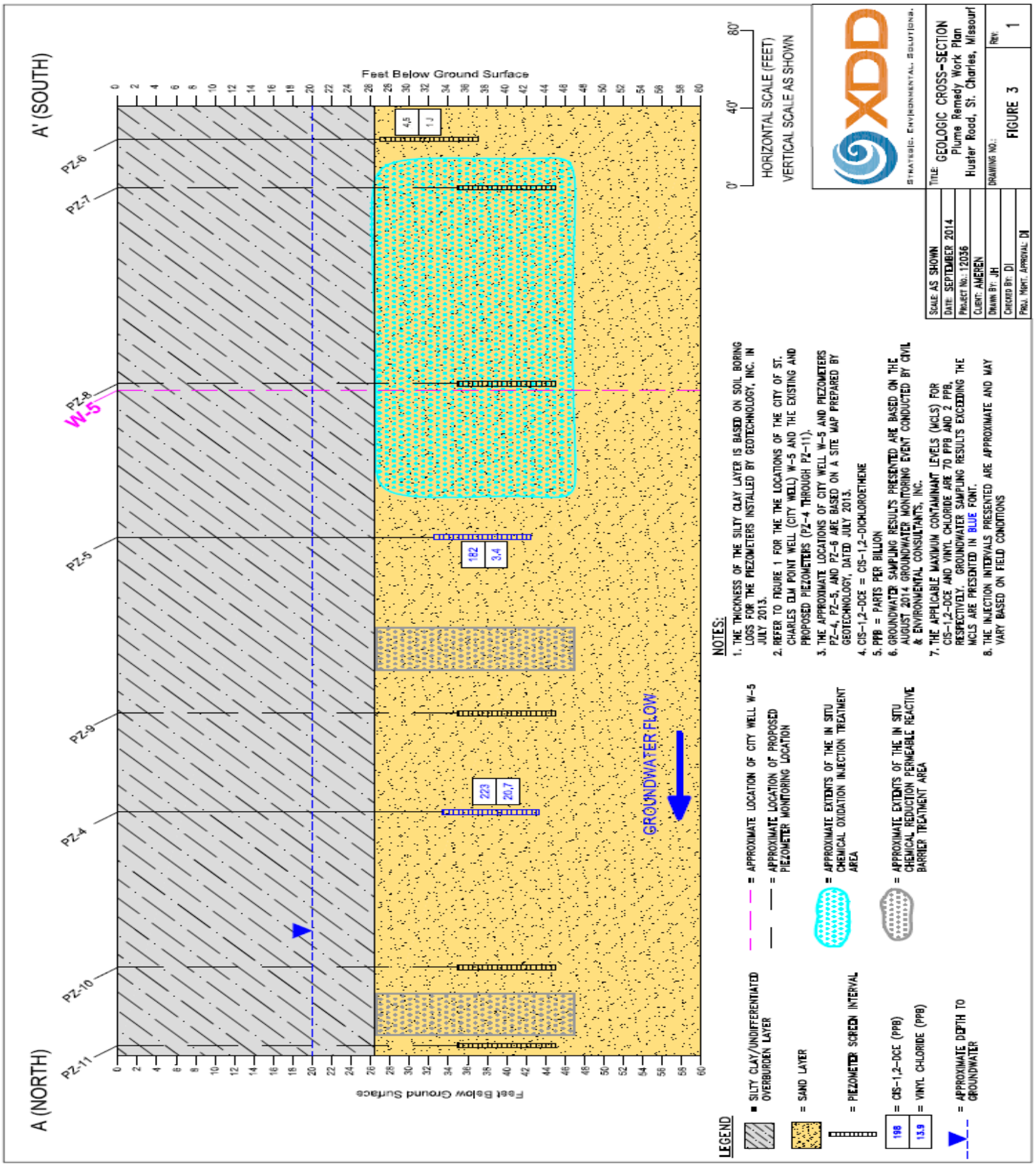


Figure 11 - Cross Section of Off-Site Pilot Study #2 Injection Locations



5.3.2 On-Site Pilot Summary #2

In pilot study No. 2, sodium permanganate was applied near transformer No. 2 and in other areas as an aggressive oxidation approach to quickly and significantly reduce COC concentrations and to limit the potential for further leaching into groundwater. A total of twenty-six (26) injection locations were used to distribute the permanganate at varying groundwater depths (maximum 28') and locations below ground surface. The sodium permanganate concentration was injected in liquid form and at a concentrations of 30-60 grams per liter (g/L). Approximately 15,755 gallons total of sodium permanganate solution was injected. (See Figure 12)

Table 2 (on page 18) depicts some limited soil sample results from the initial sampling to soil samples in 2016 which reflects the results this pilot study had on the soil concentrations on Site.

Figure 12 – Pilot Study #2 - Sodium Permanganate injections locations with amounts injected

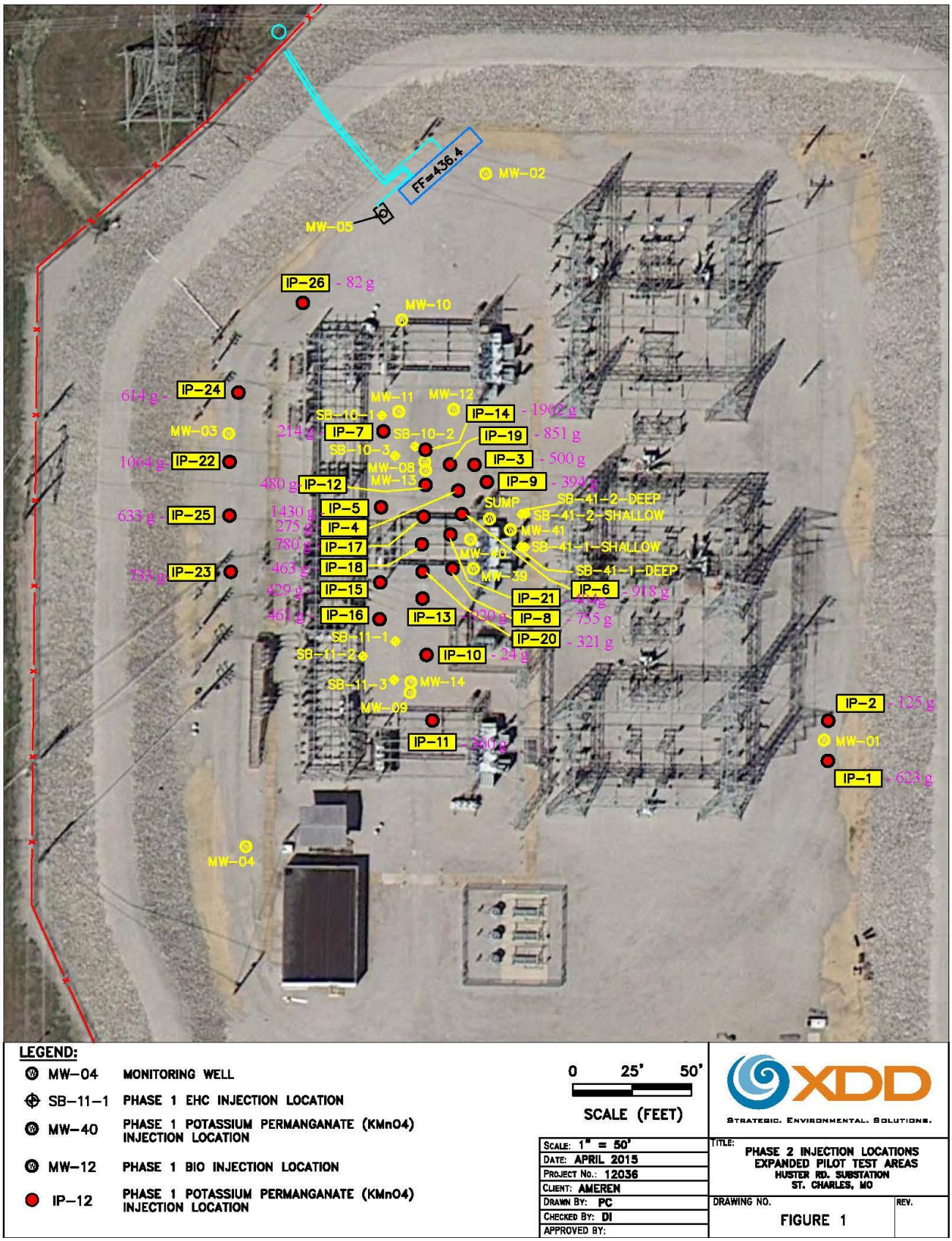


Figure 12 – Modified by Ameren

5.4 Pilot Study #3 - On-site Bio-Augmentation

In October 2016, Ameren Missouri conducted a third pilot study focused on the areas of highest impact of COCs near transformer No.2 and along the center of site (See Figures 13 & 14). This pilot expanded the biomass size injected into groundwater during the original pilot study to include groundwater below transformer No.2, the center of the substation and areas north of the distribution electrical equipment.

Within the seven (7) months following the augmentation injections, sampling data from monitoring wells MW10, MW11, and MW12, immediately downgradient of MW-8 and MW13 that exhibit the highest concentrations of COCs, reflect non-detect concentrations for all COCs. In addition, concentration levels of cis-1,2-DCE have reduced by 33% at MW8 and 40% at MW13. The VC concentrations at such locations have increased slightly, reflecting the normal decomposition process.

Figure 13 - Pilot Study #3 Bio Injection Locations

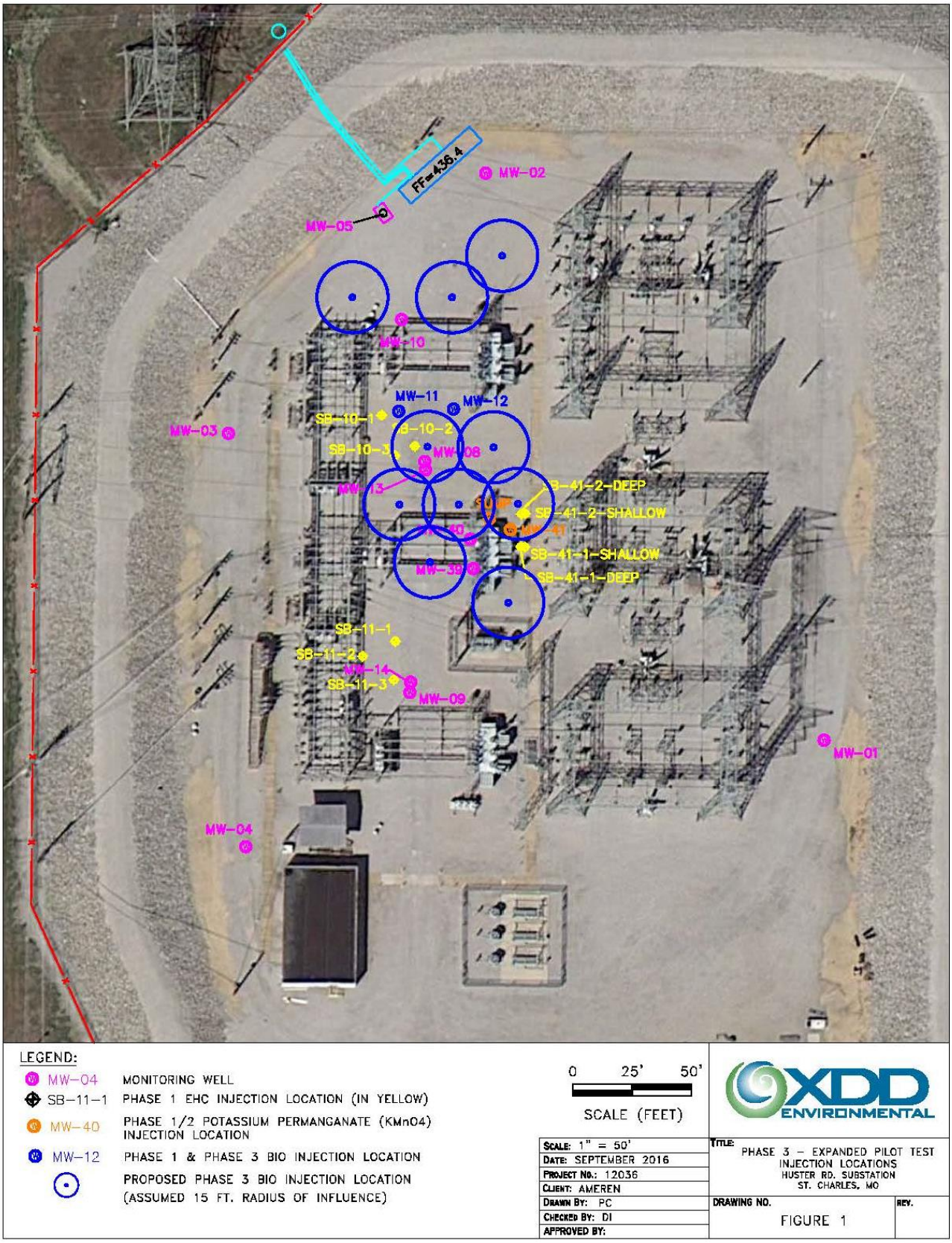
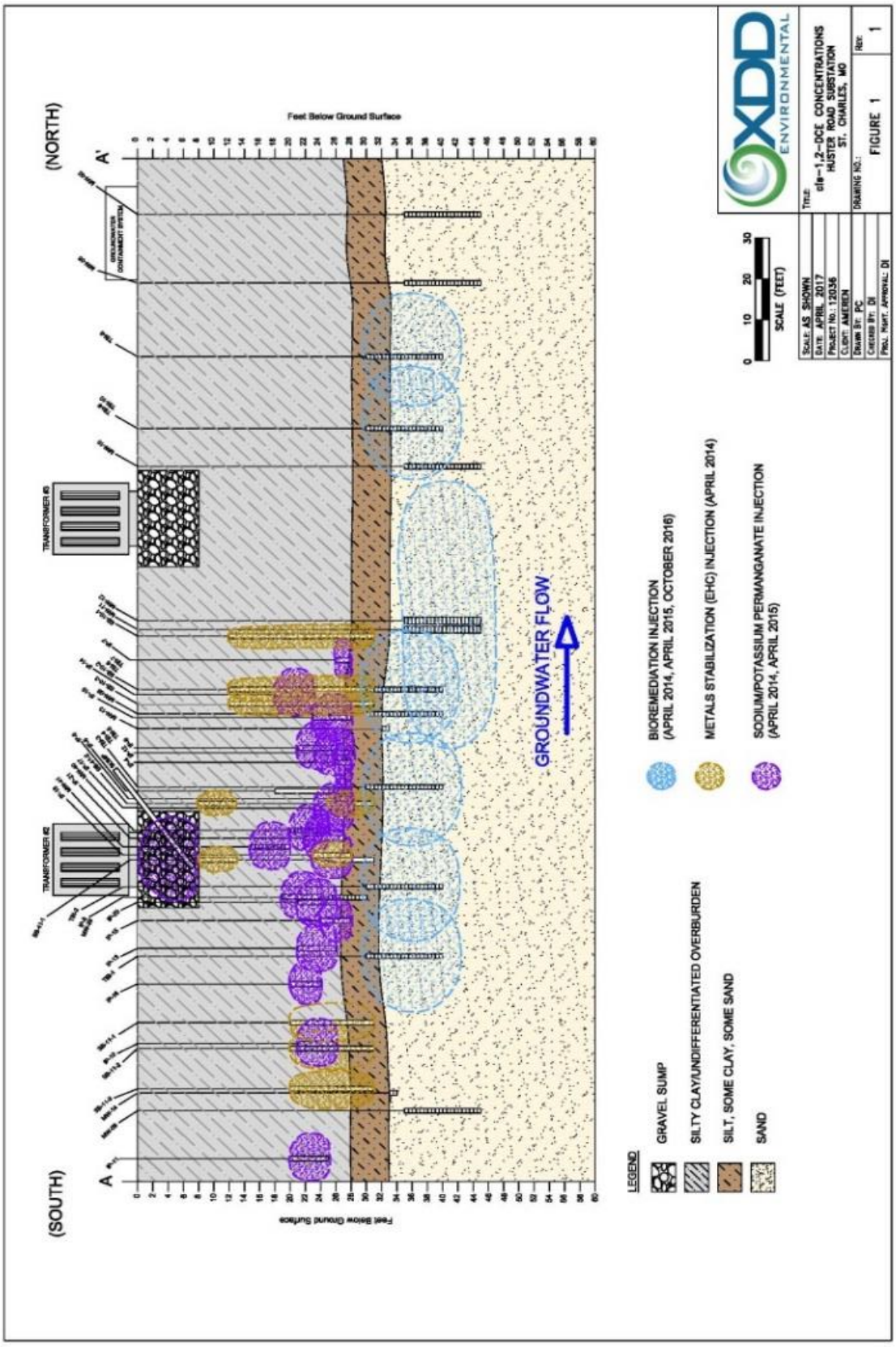


Figure 14 Cross Section of In-Situ Pilot Studies #1-3 On-Site Injections areas



5.5 Pilot Study #4 - On-site Bio-Augmentation and Injection of Sodium Permanganate

Based upon the results from prior studies, in August 2018 Ameren performed a fourth pilot study s to address concentrations of COCs in the groundwater surrounding MW-8, MW-9, MW-13, and MW-14, as well as the residual COC concentrations in the soil surrounding such wells and transformer No. 2.

Bio-augmentation was injected into MW-8 and MW-13 (the area of continued elevated levels of COCs) to enhance the breakdown of COCs and to feed the existing biomass at MW-11 and MW-12. Additional bio-augmentation was also injected in MW-9 and MW-14, as well as IP-42, 45, & 46, as the previous quarters showed increasing COC concentrations, which may be the result from leaching to groundwater from the soil.

Soil samples were taken prior to the injection of sodium permanganate into the soils and reflected concentrations greatly reduced from 2012 levels (see Appendix E). The highest concentrations of COCs found were 3,860 ppb for cis-1,2-DCE (IP-36-20.5' – 829 gallons @92g/L permanganate); 1,170 for VC (IP-27-26' – 190 gallons @92g/L permanganate); 94 J for PCE (IP-37-28' – 1,408 gallons @92/L permanganate); and 28 J for TCE (IP-37-28'). These higher concentration areas were targeted during Pilot Study #4 for additional injections of sodium permanganate (amounts indicated in parenthesis above) to further degrade the identified COCs, however the amount injected is only what the soil would receive before daylighting. (See Figure 15)

In the two months following the injections, the groundwater results reflect the following reductions:

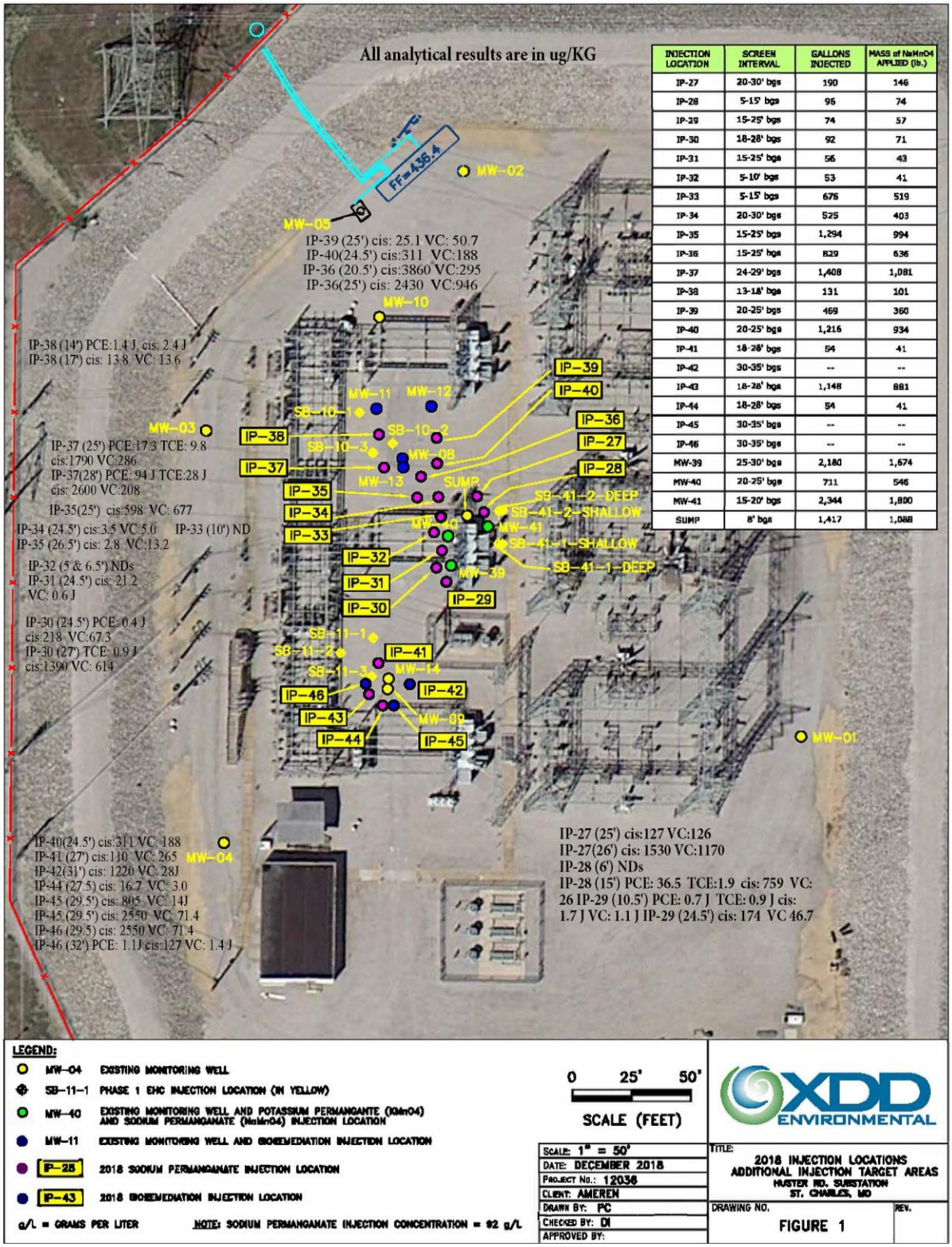
Table 4: Decreases in COCs from June 2018 to October 2018 after Pilot Study #4

Monitoring Well	June 2018		October 2018		% increase (I)or decrease (D)	
	cis-1,2-DCE	VC	cis-1,2-DCE	VC	cis-1,2-DCE	VC
MW-11	1.6 J	<2.0	1.1 J	1.0 J	No change	No change
MW-12	1.0 J	0.5 J	0.8 J	0.4 J	No change	No change
MW-9	1.2 J	0.2 J	3.8 (below MCL)	<2.0	No significant change	No change
MW-14	1,340	878	3.3 (below MCL)	18.1	100% D	98% D
MW-8	9,680	2,980	No sample	No sample	Probably 100% D [1]	Probably 100% D[1]
MW-13	32,400	1,970	12,800	7,070	60% D	259% I [2]

[1] No changes are observed at MW-8 where water samples turned purple indicating the presence of the sodium permanganate product. This however, means the COCs concentrations at this well location no longer exist as sodium permanganate instantly degrades the COCs on contact.

[2] The increase of VC (259%) reflects the normal breakdown process from cis-1,2-DCE to VC. VC actually declined from 10,200 ppb to 7070 ppb (31% decrease) from September to October 2018 – see analytical Excel MW database in Appendix E.

Figure 15- 2018 Pilot Study #4 - 92g/L Sodium Permanganate Solution Injection locations and soil analytical results



INJECTION LOCATION	SCREEN INTERVAL	GALLONS INJECTED	MASS of NaMnO4 APPLIED (lb.)
IP-27	20-30' bgs	190	146
IP-28	5-15' bgs	95	74
IP-29	15-25' bgs	74	57
IP-30	18-28' bgs	92	71
IP-31	15-25' bgs	56	43
IP-32	5-10' bgs	53	41
IP-33	5-15' bgs	676	519
IP-34	20-30' bgs	525	403
IP-35	15-25' bgs	1,294	994
IP-36	15-25' bgs	829	636
IP-37	24-29' bgs	1,408	1,081
IP-38	13-18' bgs	131	101
IP-39	20-25' bgs	469	360
IP-40	20-25' bgs	1,216	934
IP-41	18-28' bgs	54	41
IP-42	30-35' bgs	--	--
IP-43	18-28' bgs	1,148	881
IP-44	18-28' bgs	54	41
IP-45	30-35' bgs	--	--
IP-46	30-35' bgs	--	--
MW-39	25-30' bgs	2,180	1,674
MW-40	20-25' bgs	711	546
MW-41	15-20' bgs	2,344	1,800
SUMP	8' bgs	1,417	1,088

Figure 15 modified by Ameren

6. CONTAMINANT FATE AND TRANSPORT

6.1 Potential Routes of Migration

Vapor intrusion is an incomplete pathway for current land use conditions. There are no occupied structures at the Substation, and it is not anticipated that occupied structures will be built at the Substation in the future. There are currently no structures in close proximity to groundwater where VOCs have been detected. The nearest occupiable building to the downgradient edge of the plume (PZ-2) is approximately 300 feet away. Therefore, the vapor intrusion exposure pathway is incomplete under current use conditions.

Migration of contaminants via groundwater from the site is not occurring because of (a) the continuous operation of the GCS and (b) the in-situ injection of biomass near the highest areas of contamination effectively intercepting and treating contamination prior to potential migration off-site. The performance of the GCS is monitored monthly via the NPDES permit compliance sampling (the October 2018 sampling showed no COCs in the influent samples) and the weekly maintenance of the system.

6.2 Contaminant Persistence

The Site COCs are able to be treated by either oxidation, reductive de-chlorination, or bio-degradation as shown by the pilot studies performed both on-site and off-site as reflected in the Excel databases for PZs and MWs found in Appendices D & E respectively.

6.3 Contaminant Migration

There is no foreseeable potential for ingestion of contaminants from the St. Charles Well Field water supply. The sampling of the City Wells reflects no detections of COCs since 2/18/2016 and those detections were J values (below reporting limit estimations) of cis1,2-DCE at 1.4J ug/kg at City Well no. 6. Ameren has sampled City Wells 5 and 6 since approximately September 2014 and all such data (minimum of 28 samples) are below the MCLs for cis-1,4-DCE and Vinyl Chloride. Additionally, the actively pumped wells are all blended into one tank within the St. Charles Water Treatment Plant, with most of the contribution coming from City Wells #9 and #10, which were not in the off-site potential area of impact. Due to the volume of water from these two wells, there is no foreseeable potential for a detectable amount of any COC to enter the distribution water lines. In addition, St. Charles Water Treatment Plant includes aeration, lime, sodium hypochlorite, and sodium hexametaphosphate treatments. The COCs are very volatile and would easily be removed from the water during the aeration process at the plant should below MCL contaminant levels enter a City Well. These common water treatment methods are capable of removing residual VOCs from the water source prior to distribution, including those that may have originated from the Site.

7.0 BASELINE RISK ASSESSMENT

A baseline human health risk assessment (HHRA) was performed by Haley & Aldrich and is provided in Appendix F. This section provides a summary of the HHRA, which was prepared following the four-step paradigm provided in USEPA's Risk Assessment Guidance for Superfund (RAGS) document series (USEPA, 1989; 2004; 2009):

Hazard Identification – summarize Site data and select constituents of potential concern (COPCs).
Exposure Assessment – provide a quantitative estimate of potential receptor exposure to COPCs.

Toxicity Assessment – evaluate the relationship between the magnitude of exposure and the potential for occurrence of carcinogenic and noncarcinogenic health effects.

Risk Characterization – calculate estimates of potential carcinogenic and noncarcinogenic risks resulting from both current and reasonably foreseeable future human exposures to COPCs.

The results of the risk characterization are used to identify potential risks above the target risk range of $1x10^{-6}$ to $1x10^{-4}$ for carcinogens, and above a target Hazard Index (HI) of 1 for noncarcinogens (that act on the same target organ), as defined in the National Contingency Plan (NCP, USEPA, 1990) and USEPA guidance (USEPA, 1991).

7.1 HAZARD IDENTIFICATION

Soil and groundwater data were collected at the substation (defined as the land within levee for the Huster Electrical Power Substation) and soil and groundwater data were collected north of the substation (land north of the levee, up to and including the location of five piezometers installed north of Route 370).

Soil samples were collected under pre-remedial conditions in 2012 and 2013, and under post-remedial conditions in 2016 as follows:

- **2012**: 354 soil samples, including 35 field duplicates, were collected at 62 locations (SB-01 through SB-20, SB-20A through SB-41, and SS-01 through SS-20).
- **2013**: 30 soil samples, including 2 field duplicates, were collected at 3 locations (SB-42, SB-43, and SB-44).
- **2018**: 10 post-remedial soil samples were collected at 6 locations (IP-28, -29, -32, -33, -36, -38). Samples were collected between 2-10 ft bgs and 10-23 ft bgs.

The analytical data representative of both pre-remedial conditions (2012 and 2013 data) and post-remedial conditions (2018 data) were used in the HHRA. The pre-remedial data provide a conservative assessment of potential exposure conditions, recognizing that VOC concentrations in soil data from 2018 are currently lower than those represented by the 2012 and 2013 investigation data. 2018 post-remedial analytical data were used in the HHRA to provide a current assessment of potential exposure conditions.

Soil samples were analyzed for VOCs by EPA Method 8260B, PCBs by EPA Method 8082, and/or total organic carbon. Soil samples were collected from ground surface to up to 96 feet below ground surface. The analytical data are found in the HHRA's Appendix A:

The analytical data for soil were summarized separately as follows in the HHRA:

- **Table 2:** Pre-Remedial Substation soil 0 to 2 ft bgs
- **Table 3:** Pre-Remedial Substation subsurface soil 2 to 10 ft bgs
- **Table 4:** Pre-Remedial Substation subsurface soil 10 to 23 ft bgs
- **Table 5:** Pre-Remedial North of levee surface soil 0 to 2 ft bgs
- **Table 6:** Pre-Remedial North of levee subsurface soil 2 to 10 ft bgs
- **Table 7:** Pre-Remedial North of levee subsurface soil 10 to 23 ft bgs
- **Table 8:** Post-Remedial Substation subsurface soil 2 to 10 ft bgs
- **Table 9:** Post-Remedial Substation subsurface soil 10 to 23 ft bgs

Groundwater samples were collected during investigations conducted in 2012 through 2018 at up to 29 locations, and were analyzed for VOCs by EPA Method 8260. Groundwater data were selected for use in the HHRA as wells that represent the core of the substation groundwater plume (USEPA, 2014a). Samples collected between January 2017 and October 2018 (the most recent groundwater monitoring round) were selected for use in the HHRA, as they represent post-remedial conditions.

7.2 Screening of Data to Select Chemicals of Potential Concern

Soil: Screening of soil data to select chemicals of potential concern (COPCs) was conducted using the USEPA Regional Screening Levels for soil (RSLs, June 2017). Substation soil was screened using industrial RSLs, since only exposures by industrial or construction workers may potentially occur. Surface soil from locations north of the levee was screened using residential RSLs as a conservative approach. If the maximum detected concentration of an analyte in soil was above the applicable RSL, or if no screening level exists, the analyte was selected as a COPC.

Groundwater: As explained in the Exposure Assessment below, there are no complete pathways to groundwater *at the substation*; therefore, substation groundwater data were not evaluated in the HHRA. Groundwater *north of the substation levee* is a potential source of public drinking water supply with the City of St. Charles Well No. 5 located approximately 180-200 feet north of the substation, as shown on Figure 4. Installation of private water supply wells within the area north of the substation is prohibited by local ordinance. Screening of groundwater data to select COPCs was conducted using drinking water standards (Maximum Contaminant Levels; MCLs) (USEPA, 2012). If the maximum detected concentration of an analyte groundwater was above the MCL, or if no screening level exists, the analyte was selected as a COPC.

7.2.1 Summary of Chemicals of Potential Concern

COPCs that were selected at the Site are summarized below.

	Pre-Remedial Soil		**Post-Remedial Soil**	**Groundwater**	
	Substation - Commercial/Industrial		**Substation - Residential**		
COPCs	**2-10 ft**	**10-23 ft**	**10-23 ft**	**Substation**	**North of Levee**
1,1-Dichloroethene				X	
cis-1,2-Dichloroethene				X	X
Tetrachloroethene		X		X	
trans-1,2-Dichloroethene				X	
Trichloroethene	X	X		X	X
Vinyl chloride			X	X	X

Tetrachloroethylene and trichloroethylene were retained as COPCs in substation soil because maximum detected concentrations were above screening levels. Cymene was retained as a COPC because there was no screening level for comparison to the soil data.

No COPCs were identified for surface soil, subsurface soil, or groundwater north of the levee because maximum detected concentrations of constituents in those media were below screening levels, indicating that exposure pathways are not complete for those media. No COPCs were selected for groundwater beneath the substation because there are no potentially complete exposure pathways to that groundwater.

7.3 EXPOSURE ASSESSMENT

The Site is an active electrical power substation. Due to safety concerns, access to the substation is only granted to authorized personnel (Ameren employees or their subcontractors). Access by unauthorized persons does not occur due to fencing and locking gates. Ground within the substation is covered with crushed stone. The use of the land where the substation is located, including the entirety of Ameren property, is not expected to change in the future. Therefore, potential receptors at the substation under current and future conditions include:

- Industrial workers (workers who maintain the substation: current or future use)
- Construction workers (workers who may perform upgrades or modifications to the substation that involve subsurface excavation: future use)

The surrounding land use is commercial, recreational, residential, and agricultural. However, the area north of the levee is presently open space. Hypothetically, the portion of that land that is not owned by Ameren could be developed for recreational, commercial, or residential uses. Installation of private water supply wells in the area north of the levee is prohibited by local ordinance.

The linkage between a receiving medium (i.e., a medium where COPCs were identified) and potential exposure to that medium is called an exposure pathway. For an exposure pathway to be complete, the following conditions must exist (as defined by USEPA (1989)):

1. A source and mechanism of chemical release to the environment;
2. An environmental transport medium (e.g., air, water, soil);
3. A point of potential contact with the receiving medium by a receptor; and
4. A receptor exposure route at the contact point (e.g., inhalation, ingestion, dermal contact).

If any of these four components are not present, the pathway is not complete.

7.3.1 Soil Exposure Pathways

Although COPCs have been identified for pre-remedial substation soil (2-10 ft bgs and 10-23 ft bgs), there are no complete exposure pathways to soil greater than 10 ft bgs, and no COPCs were identified in post-remedial substation soil (2-10 ft bgs and 10-23 ft bgs) using industrial soil RSLs. This indicates that, based on the post-remedial (current) conditions, residual VOC concentrations in Site soils are below concentrations that would pose a de minimis risk for continued industrial use of the Site.

No COPCs were identified in post-remedial substation soil (2-10 ft bgs) using residential RSLs. Vinyl chloride was identified as a COPC in post-remedial substation soil (10-23 ft bgs) due to one exceedance of the residential RSLs at a depth of 20.5 ft bgs. However, there are no complete exposure pathways to soil greater than 10 ft bgs.

No COPCs were identified in pre-remedial north of levee soil (0-2 ft bgs, 2-10 ft bgs, or 10-23 ft bgs).

Based on the results of the COPC selection, no quantitative evaluation of risks for potential exposures to substation soil or north of levee soil is required.

7.3.2 Groundwater and Vapor Intrusion Exposure Pathways

COPCs have been identified for substation and north of levee groundwater. However, there are no current complete exposure pathways associated with potable use of groundwater. Specifically:

- Substation groundwater is not used as a source of potable water and will not be used for potable use in the future.
- Substation groundwater is not a potential source of VOCs to municipal water because the on-going groundwater containment system controls potential migration of VOCs to the north of the substation.
- No VOCs have been detected in a City of St. Charles municipal well since February 2016.
- Although COPCs were identified in groundwater north of the levee based on detected concentrations above tapwater RSLs, VOCs in groundwater north of the substation are all below the MCLs, indicating that groundwater is not a potential source to the City of St. Charles Well No. 5. Furthermore, the zero-valent iron permeable barrier controls further potential migration of VOCs north of City Well No. 5.
- Even if VOCs were detected in groundwater north of the levee at concentrations above the MCL, and groundwater entered the municipal well at concentrations above the MCL, the water from multiple city wells is blended before being distributed. The blending, as well as various drinking water treatment processes, would significantly reduce or eliminate VOCs in municipal drinking water.

Realistically, there are no complete exposure pathways to groundwater under future conditions because institutional controls will continue until groundwater COPC concentrations have achieved MCLs. However, in accordance with USEPA guidance for baseline risk assessments (USEPA, 1989), the HHRA incorporates the assumption that groundwater within the VOC plume could be used as source of drinking water in the future. Therefore, the substation groundwater data set evaluated in the HHRA represents data from the core of the groundwater plume and is used as a conservative estimate of potential future exposure. There are three exposure routes by which humans can be exposed to COPCs in groundwater: ingestion, dermal contact, and inhalation of volatiles that may be released from groundwater to indoor air during household uses of the water. Potentially complete exposure pathways for future receptors at the Site are presented below:

Receptor Type	Exposure Point	Exposure Pathway
Future Resident	Core of plume (within Substation)	- Ingestion as drinking water - Dermal Contact - Inhalation of volatiles

Vapor intrusion is an incomplete pathway for current land use conditions. There are no occupied structures at the Substation, and it is not anticipated that occupied structures will be built at the Substation in the future. There are currently no structures in close proximity to groundwater where VOCs have been detected. The nearest building that can be occupied to the downgradient edge of the plume (PZ-2) is approximately 300 feet away. Therefore, the vapor intrusion exposure pathway is incomplete under current use conditions.

To evaluate the potential for vapor intrusion to be a complete pathway if occupied buildings are constructed in the future, the maximum concentrations of VOCs that were detected in substation groundwater were compared to USEPA residential vapor intrusion screening levels (VISLs), as shown on Tables 12 and 13. Vinyl chloride was detected at a concentration in Substation groundwater above the VISL, indicating that the vapor intrusion pathway could potentially be complete if buildings were constructed over the core of the plume in the future. No VOCs were detected in groundwater north of the levee at concentrations above VISLs, indicating that the vapor intrusion pathway would not complete if occupied buildings were constructed over that portion of the plume.

Direct contact with groundwater is an incomplete exposure pathway for all receptors. Of the receptors identified at the Site, only construction workers are anticipated to do subsurface work (i.e., deeper than 3 ft bgs). However, it is anticipated that future construction would not likely extend deeper than 10 feet below ground surface. Groundwater depths measured during site investigation activities range from 12 ft bgs to 23 ft bgs. Consequently, groundwater is not expected to be encountered during construction activities.

7.4 TOXICITY ASSESSMENT

A Toxicity Assessment was conducted and is provided in Attachment E (of the HHRA). A summary of the toxicity assessment is provided below. The toxicity values are presented in Tables 16 through 19 (of the HHRA).

- **Chronic Non-Carcinogenic Health Effects:** USEPA has established chronic non-carcinogenic health criteria termed reference doses (RfDs) for oral and dermal exposure routes, and reference concentrations (RfCs) for the inhalation exposure route. The derivation of RfDs and RfCs is described in Attachment E. The RfD and RfC are each a daily intake level for the human population, including sensitive subpopulations, that are not expected to cause adverse health effects over a lifetime of exposure (USEPA, 1989). It should be noted that RfDs and RfCs are generally very conservative (i.e., health protective) due to the use of large uncertainty factors. Chronic RfDs and RfCs were used to quantify non-carcinogenic risks for the future resident scenario evaluated in this HHRA, consistent with USEPA guidance (USEPA, 1989).

- **Carcinogenic Health Effects:** USEPA has established cancer toxicity values termed cancer slope factors (CSFs) for oral and dermal exposure routes, and unit risks (URs) for the inhalation exposure route. A discussion of the modeling that has been conducted to describe the expected quantitative relationship between dose of a carcinogen and associated risk of developing cancer is provided in Attachment E (of the HHRA).

  USEPA uses both an alpha-numeric system and a weight-of-evidence-based descriptive narrative to describe the carcinogenic potential of an agent. Descriptors are provided in Attachment E (in the

HHRA). The carcinogenic potential for COPCs identified in environmental media at the Site is provided below:

- 1,1-Dichloroethene, 1,2-Dichloroethene (cis), and 1,2-Dichloroethene (trans) have inadequate evidence to determine carcinogenic potential.
- Trichloroethylene is classified as 'Carcinogenic in Humans' by the oral/dermal and inhalation exposure routes. Trichloroethylene is also classified as a mutagen under current USEPA cancer guidelines (USEPA, 2018d). Age-dependent adjustment factors are used to account for mutagenicity and are applied to evaluate child exposure receptors (USEPA, 2018d).
- Tetrachloroethylene is classified as 'Likely to be Carcinogenic in Humans' by the oral/dermal and inhalation exposure routes.
- Vinyl chloride is classified as 'Known human carcinogen' by the oral/dermal and inhalation exposure routes. Vinyl chloride is also classified as a mutagen under current USEPA cancer guidelines (USEPA, 2018e). Age-dependent adjustment factors are used to account for mutagenicity and are applied to evaluate child exposure receptors (USEPA, 2018e).

- **Toxicity Values for Dermal Exposure:** Route-specific toxicity values are not available for the dermal pathway and are, therefore, extrapolated from the oral toxicity values following USEPA guidance (USEPA, 2004), as described further in Attachment E of the HHRA.
- **Sources of Dose-Response Values:** The sources used to identify dose-response values for this HHRA are consistent with USEPA guidance and are provided in Attachment E of the HHRA.

7.5 RISK CHARACTERIZATION

Potential future resident (adult and child) exposure to substation groundwater is associated with an ELCR of 2E-01. The cancer risks are above the NCP risk range of 10^{-6} to 10^{-4}. The cumulative HI is 964, which is above the target HI of 1. COPCs in substation groundwater have RfD and RfC values that are based on effects to different target organs, as shown in Tables 18 and 19 (of the HHRA). The HI's for substation groundwater based on target organ are also above 1 (Table 20 in the HHRA).
As shown in Table 12 (of the HHRA), maximum detected COPC concentrations within the core of the plume are between one and four orders of magnitude higher than VISLs. This indicates that if construction of an occupied building was to occur over the core of the groundwater plume, vapor intrusion exposures could be associated with risks above the NCP acceptable risk levels, and that further assessment of the vapor intrusion pathway would be required.

8.0 CONCLUSIONS

The pilot studies have been effective in significantly reducing the concentrations of COCs off-site and on-site to the level where further remediation would not be required. The GCS has been and is effective in maintaining all remaining COCs in the groundwater on-site. The bio-augmentation is effectively reducing the concentrations of COCs in the groundwater and providing a biomass that is effectively keeping higher concentrations on-site while it continues to degrade the COCs. The sodium permanganate injections in the clays, are effectively reducing and/or eliminating the COCs in the soil to the point that leaching to groundwater potential is minimal.

The results of the HHRA support the following conclusions:

- Post-remedial soil concentrations are below USEPA RSLs for receptors that would reasonably be expected to access an active electrical power substation (industrial workers and construction workers). Furthermore, post-remedial soil concentrations are below residential RSLs. No further remediation of soil is necessary to mitigate health risks associated with potential exposures to substation soil.
- No analytes were retained as COPCs in soil north of the levee, indicating that there are no complete exposure pathways to that soil. Therefore, soil north of the levee does not pose health risks above USEPA risk management ranges. No further remediation of soil is necessary to mitigate health risks associated with potential exposures to soil north of the levee.
- There are no complete exposure pathways to groundwater north of the levee and, therefore, groundwater north of the substation does not pose health risks in excess of USEPA risk management criteria. VOCs were not detected in groundwater north of the levee at concentrations above drinking water standards (MCLs), indicating that the remedial actions at the Site have reduced VOC concentrations in groundwater north of the levee to potable use targets. Based on the data evaluated in the HHRA, no further remediation of that groundwater is required to ensure that groundwater north of the levee meets drinking water standards and is not a potential source of VOCs to the municipal water supply.
- VOCs are not present in groundwater north of the levee at concentrations that exceed vapor intrusion screening levels, and the shortest distance between the leading edge of the plume (PZ-2) and the nearest existing occupied building is approximately 300 feet (building located to the north of 370). Therefore, the vapor intrusion pathway is not currently complete. VOCs were detected in substation groundwater at concentrations above vapor intrusion screening levels, indicating that the vapor intrusion pathway could be potentially complete if occupied buildings were constructed in that area the future.
- Although groundwater at the substation poses health risks above USEPA risk management ranges for a future residential scenario, there are no current complete exposure pathways to groundwater beneath the substation and, therefore, substation groundwater does not pose health risks in excess of USEPA risk management criteria under current use conditions. Risks above USEPA risk management criteria for future use conditions indicate that institutional controls must continue to be used until residual VOC concentrations have been reduced to meet drinking water standards.